SECTION 2. CURRENT WATERSHED CONDITIONS

This section summarizes the results of several watershed assessments that have been conducted for this project. The assessments include channel enlargement, stream geomorphology, physical conditions, hydrologic, and public involvement. The discussion in this section has been limited to a presentation of findings and results. Technical theory and methodology discussions are provided in the appendices to this report.

2.1 Channel Evolution and Channel Enlargement

An important task of the Watts Branch project is to define the stream channel geomorphic characteristics. The assessment of the physical characteristics of the stream channel serves as an important foundation of the stream rehabilitation strategies and provides a reference on where the stream is in its evolutionary process. As stated in the introduction, streams characteristically enlarge as result of urbanization. This section provides a summary of the channel enlargement study results from the analysis of ten stations (study points) along the mainstem of Watts Branch (see Figure 2.1 for station locations).

2.1.1 The Concept of Channel Enlargement

The first evidence that stream channels enlarge in response to watershed development can be found in the high bank erosion rates measured for urban streams. Bank erosion accounted for an estimated two-thirds of the measured instream sediment load of an urban stream in California (Trimble, 1997). In contrast, most geomorphologists have found that bank erosion in rural streams comprises only 5% and 20% of the annual sediment budget (Walling and Woodward, 1995; Collins *et al.*, 1997). Research indicates that channel enlargement can begin at a relatively low level of watershed development, as indicated by the amount of impervious cover. One study estimated that channel erosion rates were three to six times higher in a moderately urbanized watershed (14% impervious cover) than in a comparable rural one, with less than 2% impervious cover (Neller, 1988).

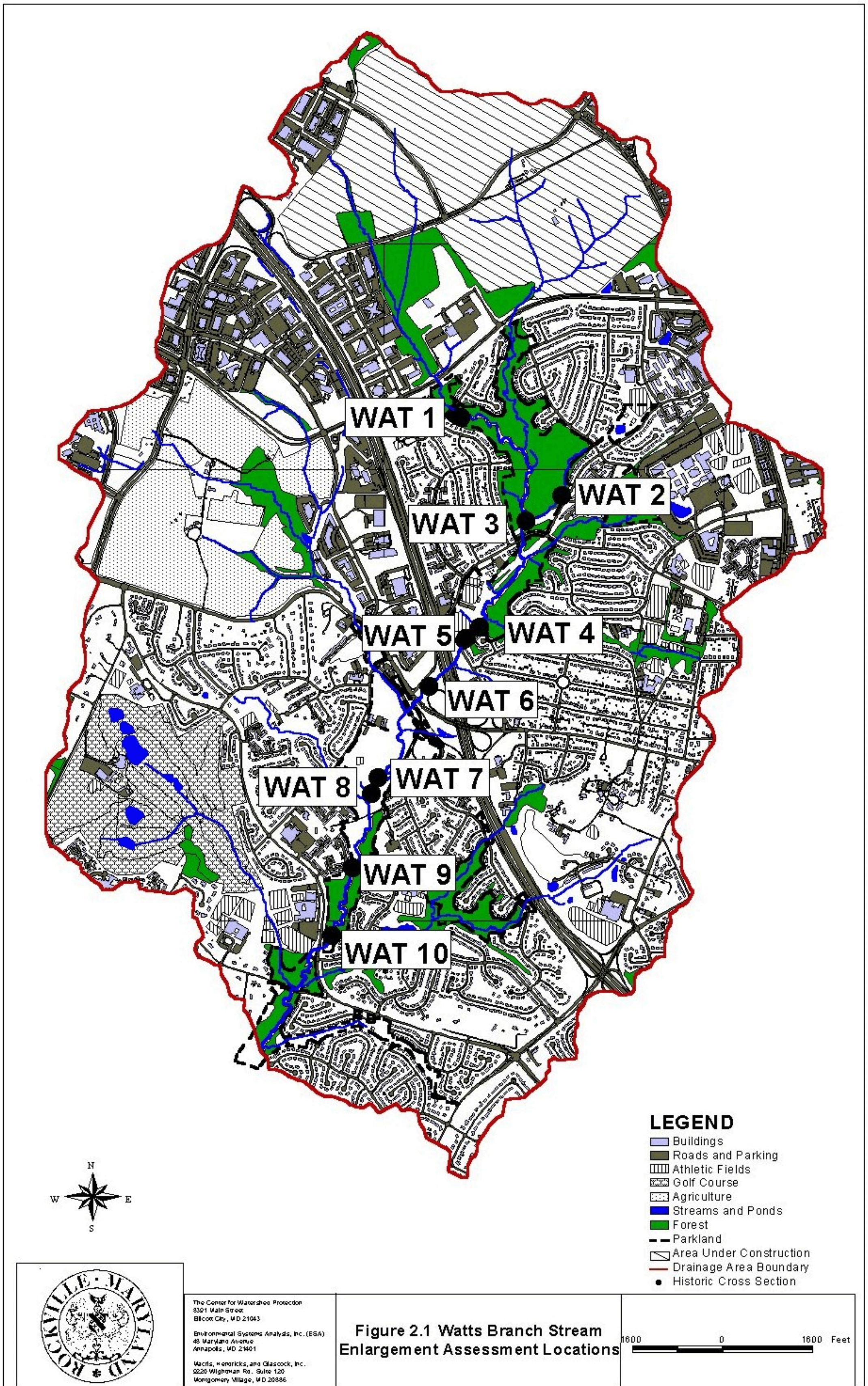
Further evidence that stream channels enlarge in response to watershed development lies in studies that have tracked the change in the cross-sectional area of stream channels over time. The simplest way to quantify these changes is to define an “enlargement ratio,” which represents the ratio of a stream’s current cross-sectional area to its pre-development cross-sectional area (or, in some cases, a cross-section from an adjacent undeveloped stream of equivalent watershed area) (Caraco, 2000).

The enlargement ratio takes the following form mathematically:

$$(\mathrm{Re})_{POST} = \left(\frac{(A_{BFL})_{POST}}{(A_{BFL})_{PRE}} \right)$$

where Re is defined as the channel enlargement ratio, 'A' represents the cross-sectional area of the stream channel, and the subscripts BFL, POST, and PRE refer to the bankfull stage, the post-disturbance condition, and pre-disturbance condition, respectively.

Figure 2.1 Watts Branch Stream Enlargement Assessment Location



It is worth noting that the bankfull stage does not necessarily mean the "top of bank," but rather refers to the water surface elevation associated with the dominant discharge for the particular channel. For unimpacted streams, this may in fact be the "top of bank," but generally for incised urban streams, this elevation tends to be somewhat less than the "top of bank."

The age of the development is also a critical variable in the amount of channel enlargement. In general, the longer a channel is exposed to the forces causing accelerated channel erosion, the larger the channel cross-sectional area, at least until such time as a channel has enlarged sufficiently to be in balance with the altered hydrologic forces caused by development. The effect of the age of development is represented by the concept of a "relaxation period." This is defined as the period of time required for a channel to reach an "quasi-equilibrium" state in concert with the level of watershed alteration, where the channel erosion processes are in a relative balance with the watershed forces causing erosion. The relaxation period for watersheds such as Watts Branch (i.e., alluvial streams) is estimated to be about 67 years (see Appendix A for a more detailed discussion).

The basic methodology to calculate channel enlargement relies on obtaining historical cross-sectional data from past surveys (often obtained from transportation agencies or public works departments that conducted surveys at the time of road construction or improvement projects) and comparing these with current cross-sectional data obtained from field surveys conducted at the time of the study. The approach also utilizes predictive (i.e., empirical) equations to estimate an ultimate channel enlargement ratio once the channel has enlarged sufficiently to be in balance with its hydrological forces. The reader is referred to Appendix A for a more detailed discussion on channel enlargement theory and assessment methodology.

To illustrate the concept of channel enlargement and how a channel responds over time to the effects of urbanization, it is useful to compare a channel cross-section over time. Figure 2.2 illustrates this change in channel morphology by comparing the cross-sectional area of a channel at three distinct points in time: historic, current, and ultimate. It is important to note that while the historic and current cross-sections are based on actual data, the ultimate cross-section is a hypothetical configuration based on a predicted increase in cross-sectional area.

Channel enlargement is also quite apparent in the field (Figure 2.3; same cross-section as shown in Figure 2.2). The exposed sanitary sewer manhole in the channel is due to a combination of plan form (i.e., lateral) adjustment of the channel as well as enlargement.

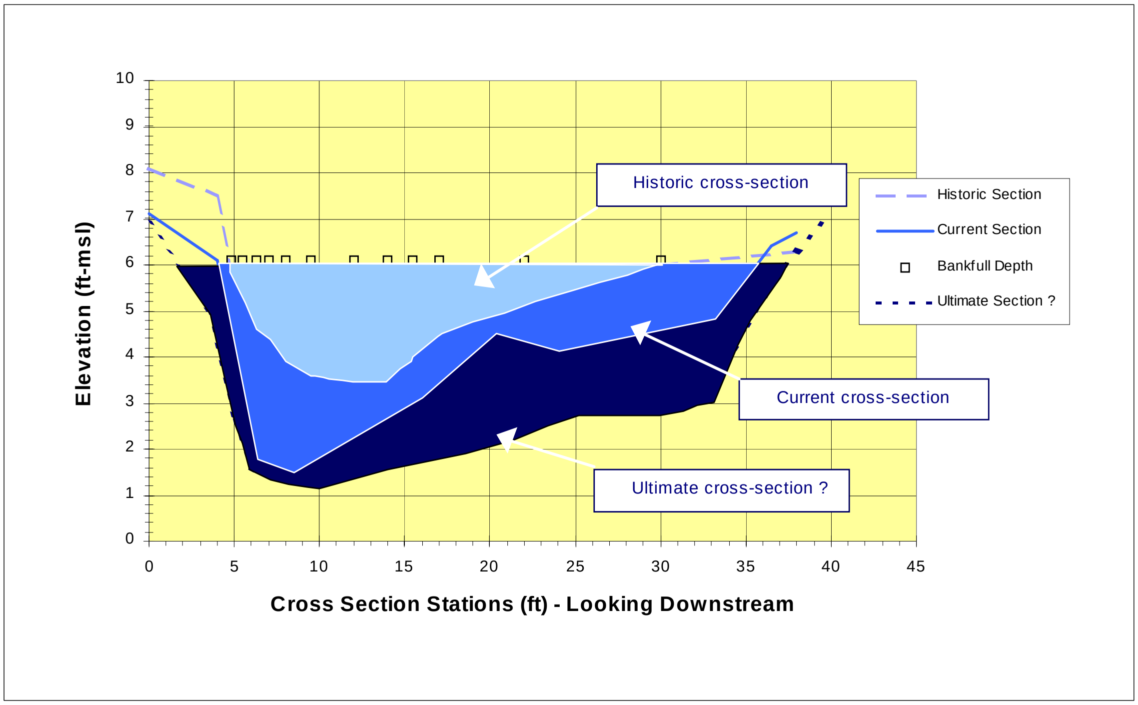


Figure 2.2 Watts Branch cross-section comparison (Note: cross-sections have been overlain for illustrative purposes only–actual sections do not share same datum.)

Figure 2.3 Photo looking downstream showing exposed manhole and enlarged channel

2.1.2 Results of Channel Enlargement Analysis

The primary objectives of the channel enlargement assessment were to:

Scenario 1. validate an empirical assessment technique to determine what the ultimate channel enlargement will be at each of the ten stations,

Scenario 2. determine where Watts Branch generally falls in the channel evolutionary process, and

Scenario 3. use the analysis to formulate stormwater rehabilitation strategies in the Watts Branch watershed.

The starting point for all of the enlargement analysis is to collect current conditions channel morphology and hydrologic data at each of the study points. A summary of these channel data at the ten cross-section locations, as determined from field surveys, is presented in Table 2.1.

Table 2.1 Summary of Channel Bankfull Data Under Current Conditions

Site	DA (acres)	I (%)	D_{BFL} (ft)	w_{BFL} (ft)	A_{BFL} (ft^2)	n_{BFL}	S (ft/ft)	Q_{BFL} (cfs)
WAT 1	364	34.5	2.1	15.3	24.6	0.033	0.010	143
WAT 2	151	50.2	1.5	18.3	22.9	0.034	0.011	116
WAT 3	832	26.6	2.15	22.9	35.8	0.026	0.005	186
WAT 4	1540	28.6	3.0	36.2	86.5	0.036	0.009	587
WAT 5	1540	28.6	2.6	32.9	61.8	0.031	0.013	496
WAT 6	1653	30.1	3.1	30.4	68.5	0.034	0.010	493
WAT 7	2443	31.3	4.0	27.0	70.3	0.034	0.008	481
WAT 8	2479	31.1	3.6	21.0	61.2	0.034	0.008	438
WAT 9	2829	30.3	3.5	31.3	98.9	0.035	0.007	694
WAT 10	2860	30.1	4.2	36.5	119.3	0.031	0.004	750

DA = Drainage area; I = Basin Imperviousness; D_{BFL} = Bankfull channel depth; W_{BFL} = Bankfull channel width; A_{BFL} = Bankfull channel cross-sectional area; n_{BFL} = Manning roughness coefficient at bankfull depth; S = Channel longitudinal slope; Q_{BFL} = Channel bankfull flow rate

The current bankfull cross-sectional areas and flows are, in turn, used to estimate historic cross-sectional area and to forecast the ultimate cross-sectional area.

Once the empirical approach is determined to be valid based on the observed Watts Branch data, it is then possible to apply the channel enlargement regression equation to estimate the ultimate channel enlargement conditions <u>based on future build-out predictions</u> (this primarily involves the additional development of the King and Thomas Farm parcels within the Watts Branch watershed). The estimated ultimate enlargement results are then used as one of a suite of indicators for development of stream rehabilitation and stormwater retrofit strategies.

Table 2.2 presents the results of the analysis, including the estimated impervious cover for each of the drainages tributary to the ten stations under projected full build-out conditions. The regression equation for the channel enlargement yields the build-out ultimate channel enlargement ratio. The estimated ultimate channel cross-sectional area is determined by multiplying the ultimate enlargement ratio by the pre-disturbance cross-sectional area.

Table 2.2 Ultimate Channel Enlargement Ratios and Cross-Sectional Area Assuming Full Watershed Build-out

Site	Est. Build-out I[1] (%)	Current $(Re)_i$	Build-out $(Re)_{ULT}$	Current A_{BFL} ft^2	Build-out ft^2
WAT 1	60	2.1	6.65	24.6	77.1
WAT 2	50	1.9	5.09	22.9	60.6
WAT 3	54	2.0	5.62	35.8	102.4
WAT 4	43	2.0	4.14	86.5	176.4
WAT 5	43	1.7	4.14	61.8	153.7
WAT 6	44	1.8	4.21	68.5	158.6
WAT 7	45	2.1	4.45	70.3	150.1
WAT 8	45	1.1	4.40	61.2	243.8
WAT 9	43	1.2	4.06	98.9	323.8
WAT 10	42	1.4	4.03	119.3	341.6

[1] Impervious cover estimates based on assumed build-out of King and Thomas Farms at 52 and 48 percent impervious, respectively

$(Re)_i$ = current enlargement ratio; $(Re)_{ULT}$ = ultimate enlargement ratio; A_{BFL} = bankfull cross-sectional area

2.1.3 Management Implications

The channel enlargement analysis documents some findings about how Watts Branch has changed over time. First, based on the area weighted average age of disturbance (i.e., the approximate time that has elapsed since development began) for each of the ten study points, the observed channel locations are only about 30 to 40 percent of the way along their evolutionary process[1]. The total time for the enlargement process to occur in alluvial streams such as Watts Branch is estimated to be 67 years (MacRae, 1999) from the onset of significant land use changes within the watershed. Therefore, we can expect to see another 40 to 50 years of channel reaction and adjustment to development influences before a state of quasi-equilibrium is reached.

Second, the existing channel cross-sectional area is expected to increase between two and four times, depending on the study point (Table 2.2). For example, the current bankfull cross-sectional area at WAT 1 of 24.6 square feet is projected to ultimately enlarge (at full build-out) to a bankfull cross-sectional area of 77.1 square feet, or about a three fold increase. The significant changes in channel enlargement have occurred, in some cases, where stormwater control practices exist upstream. This suggests that the method of control employed in the past has been ineffective at protecting the channels from erosive stormwater flows.

[1] Geomorphic changes and responses do not occur immediately upon a change in the land use in a watershed. The channel alteration, adjustment, and transition processes occur over several years, depending on the basic geomorphic stream type. For alluvial streams like Watts Branch, this process can take as long as 70 years.

The two findings above are important to the overall strategy that is taken from a stream rehabilitation and stormwater retrofit standpoint. Specifically, since the study points all indicate that the stream channel still has a long way to go before reaching a state of relative equilibrium, the in-stream rehabilitation techniques implemented should be able to withstand future adjustments in channel downcutting, widening, and plan form. Stream rehabilitation techniques such as live stakes and coconut rolls are examples of practices that provide flexibility that allow for some channel movement[2]. In addition, because there is a large increase in channel cross-sectional area predicted, a focus of the stormwater retrofitting sites will be to provide channel protection storage (i.e., 24-hour extended detention of the 1-year return frequency storm) to help mitigate the erosive forces associated with the stormwater runoff.

It will also be necessary to coordinate and optimize the stream rehabilitation and stormwater retrofit strategies outlined above. In other words, in-stream rehabilitation measures will be that much more effective if they can be combined with retrofit controls immediately upstream that will help control the volumes, rates and flow frequency of erosive conditions.

It is important to note that the ultimate build-out analysis does not account for the effectiveness of more advanced stormwater management techniques that have been or will be implemented with the development of the King Farm and Fallsgrove parcels. With some of the more stringent controls in place (e.g., channel protection design criteria requiring 24-hour extended detention of the 1-year return frequency storm), it is hoped that the projected channel enlargement will be less significant. The efficacy of these criteria is still largely theoretical, and it will require monitoring and data collection to adequately assess them.

2.2 Stream Channel Conditions

Two in-stream assessments techniques were performed to evaluate overall stream channel conditions. The assessments included a rapid geomorphic assessment (RGA) and a rapid stream assessment technique (RSAT). The RGA was performed to evaluate channel stability at each of the ten field survey sites in the Watts Branch watershed. As previously described in Section 2.1, the ten locations were chosen based on the representativeness of each reach and correspond to where historic cross-sectional information existed. In addition, the RGA serves as the data collection tool from which much of the channel enlargement analysis is generated. The RSAT was implemented to determine the physical attributes of all perennial reaches of Watts Branch. Observations were recorded at approximately 400-foot intervals and wherever unique conditions or potential problems were apparent. Evaluation categories include channel stability, channel scouring and deposition, physical in-stream habitat, water quality, riparian habitat condition, aesthetics and remoteness. Findings of the RSAT assist in identifying candidate sites for stream rehabilitation, reforestation, and wetland improvement. A more detailed description of the methodologies and findings of these two assessments is provided below.

[2] There are some stream rehabilitation sites that will require a more rigid design to protect utilities, infrastructure, or property concerns.

2.2.1 Rapid Geomorphic Assessment

The Rapid Geomorphic Assessment process uses a number of visually observed factors to provide a semi-quantitative assessment of a stream's current stability (CWP& MacRae, 1999). A length of approximately ten times bankfull channel width is investigated at each site to determine geomorphic and channel metrics. The primary purpose of the RGA is to corroborate the findings of the more quantitative channel enlargement assessment and to help define past or current modes of channel adjustment (i.e., aggradation, degradation, widening and/or plan form adjustment). The RGA notes whether change in channel form has occurred or is still occurring, however, it does not provide a measure of the rate of change.

The process consists of identifying the presence of in-stream channel features resulting from a variety of geomorphic processes. The protocol is comprised of four factors: Aggradation (AI), Degradation (DI), Channel Widening (WI), and Planimetric Form Adjustment (PI). Each Factor consists of seven to 11 indices, which are measures of the morphological state of the channel. For example, presence of leaning trees, fence posts, etc., to which the observer is required to provide a “yes” response if present or “no” response if absent. The total number of “yes” responses is totaled for each Factor and divided by the total number of “yes” and “no” responses to derive a Score for each Factor. These Scores are then summed and divided by four to arrive at the Stability Index (SI), as presented in the following equation:

$$SI = \frac{AI + DI + WI + PI}{m}$$

in which ‘m’ is the number of factors (four for alluvial streams like Watts Branch).

The stability index (SI) provides an indication of the stability of the creek channel at a given time. The observed geomorphic features may be current or historic. Consequently, other corroborative levels of investigation (e.g., enlargement analysis) are necessary to determine whether evidence of instability is associated with current processes and what the magnitude of the activity rates may be. Previous experience with the RGA protocol indicates that the Score values may be interpreted as follows:

Stable ($SI \leq 0.2$):	Channel metrics are within the expected range of variance (one standard deviation from the mean)
Transitional ($0.2 < SI \leq 0.4$):	Channel metrics are within the expected range of variance for a stable condition but channel shows signs of stress; and,
In Adjustment ($SI > 0.4$):	Channel is outside of the expected range of variance and evolving toward a new equilibrium position.

A summary of the Stability Index values and classification is presented in Table 2.3, and the RGA field survey forms for each station are presented in Appendix B.

Table 2.3 Summary of Channel Stability Assessment Using the Rapid Geomorphic Assessment Form

Basin	Site ID	RGA Factor				Stability Index	Stability Class
		AI	DI	WI	PI	(SI)	
Watts Branch	WAT 1	0.29	0.40	0.63	0.14	0.37	Transitional
Watts Branch	WAT 2	0.43	0.38	0.56	0.43	0.45	In Adjustment
Watts Branch	WAT 3	0.71	0.17	0.50	0.29	0.43	In Adjustment
Watts Branch	WAT 4	0.29	0.38	0.75	0.43	0.47	In Adjustment
Watts Branch	WAT 5	0.86	0.25	0.63	0.29	0.50	In Adjustment
Watts Branch	WAT 6	0.29	0.33	0.83	0.86	0.59	In Adjustment
Watts Branch	WAT 7	0.29	0.43	0.75	0.57	0.52	In Adjustment
Watts Branch	WAT 8	0.57	0.40	0.50	0.43	0.48	In Adjustment
Watts Branch	WAT 9	0.57	0.10	0.44	0.14	0.30	Transitional
Watts Branch	WAT 10	0.17	0.14	0.56	0.00	0.24	Transitional

Notes
SI = Modified Stability Index for Watts Branch Conditions; AI = Aggradation Factor; DI = Degradation Factor; WI = Widening Factor; PI = Planimetric Adjustment Factor

The RGA also includes the collection and recording of several other factors such as bed material characteristics to determine roughness coefficients and channel bank soil consistency to help assess historic degradation and aggradation patterns. These data are also used in the bankfull flow calculations and are important in the development and verification of the channel enlargement analysis. The following discussion describes each of these elements.

Bed Material Assessment

Pebble counts were used to characterize the bed material. Samples were collected near the location of the primary cross-section along a transect perpendicular to the banks running from left bank toe to right bank toe. The pebble counts consisted of measuring the lengths of the three major axes; length (l), width (w), and height (h), of individual pebbles obtained through random grab samples along the transect. A minimum of 50 pebbles were collected at each station to obtain the above metrics. Data collection included all particles regardless of size including large anomalous boulders. The data were then used to calculate a pebble size distribution or mass curve. In determination of the mass curves, however, the largest particle, if more then 15% larger than the second largest particle, was removed from the analysis.

The data were used to help classify the channel in the RGA analysis as well as determining roughness coefficients (Manning's n values) for the bed material, which were in turn used to develop the current estimates for bankfull flows and cross-sectional areas.

Bank Soil Survey

Bank materials were analyzed during the field study using standard soil consistency tests: stickiness (X1), plasticity (X2), and firmness (X3) (see Diagnostic Geomorphic Field Survey Form, Appendix B). These metrics were determined for each definable soil horizon or stratigraphic unit on both left and right banks. The three metrics were then summed to determine a value that was subsequently correlated with shear stress for use in classifying the channel in the RGA analysis. The soil survey data were also used for the determination of bank roughness coefficients.

Field Sketches

Sketches of the channel in plan form were made 50 feet upstream and downstream of the cross-section location as well as sketches of the left bank and right bank profiles as part of the field notes for each site. Features in the plan form sketches consisted of riffle and pool location, point bars, lobate bars, sloughing banks, large organic debris, and other significant channel characteristics. Features in the bank profiles included in these sketches consisted of soil horizons, bank vegetation, major terraces and approximate elevations of such features.

2.2.2 Rapid Stream Assessment Technique (RSAT)

Environmental Systems Analysis, Inc. (ESA), in cooperation with the Center for Watershed Protection and the City of Rockville Department of Public Works, evaluated and characterized the physical characteristics of approximately 12.5 miles of perennial streams (streams which flow year round) within the City of Rockville which are part of the Watts Branch watershed. This assessment was performed using a field method known as the Rapid Stream Assessment Technique (RSAT) (Galli, 1996). This technique was modified to ensure compatibility with project objectives and resources for the study area. The modified RSAT was used to evaluate more than 30 physical stream conditions at stations located at 400-foot intervals (between 12 and 13 observation points per mile), or wherever unique conditions or potential problems were apparent. Evaluation categories included channel stability, channel scouring and deposition, physical in-stream habitat, water quality, riparian habitat condition, aesthetics and remoteness.

Figure 2.4 identifies the stream reaches that were assessed using RSAT. As described in Section 1.3, the numbering convention used to identify reaches is based on the order of the stream (e.g., first order through fourth order). For example, there is one fourth order reach (i.e., 401), two third order reaches (i.e., 301 and 302), six second order reaches and so on. Stream reaches were numbered in a clockwise direction starting with first order streams at the most downstream point. Under this convention, the southern most first order tributary found on the Lakewood Country Club property was numbered 101.

All of the perennial streams in the Watts Branch watershed within the City were physically surveyed. Severe drought conditions were present throughout Maryland in 1999, and as a result, low baseflow or sub-baseflow conditions were observed in all streams. A total of 165 stations were visited, with 132 stations actually being investigated using modified RSAT data collection protocols (see Figure 2.5). The remaining thirty-three stations were not conducive for RSAT evaluation because they lacked either a riffle (extensive run or pool) or were found to be ephemeral or intermittent, concrete lined, or piped (closed section). Photographs of each station were previously provided to the City and are on file at the Department of Public Works as part of the project record (see Appendix F for a list of additional information on file with the City). Original data sheets for each observation point are included in the full report which is in Appendix C.

ESA modified the RSAT to ensure compatibility with project objectives and stream resources contained within the study area after approved by the City of Rockville. A major component of this study is the RSAT scoring system which provides a numeric score for each station based on the following seven evaluation criteria:

- Channel stability: Assessment of bank stability / degree of erosion.
- Channel scouring / sediment deposition: Assessment of stream scour and sediment load based primarily on the amount of embedded substrate.
- Physical in-stream habitat: An assessment of in-stream habitat based on wetted perimeter, pool depth and cover, substrate composition and overall diversity.
- Water quality: An indirect assessment of water quality based on water clarity and substrate fouling.
- Riparian habitat conditions: Evaluation of riparian habitat based on canopy closure, buffer width, and presence of wetlands.
- Aesthetic rating: An evaluation of the amount of disturbance (refuse, invasive plants, etc.) to the stream and riparian community.
- Remoteness: The degree to which the station is removed from access points such as trails and roads.

Scores were assigned for each of these categories, the sum of which provides the numeric score for the station (see Table 2.4 for a breakdown of the criteria scoring). A ranking of “Excellent”, “Good”, “Fair”, and “Poor” was then assigned to each station based on the following score ranges:

Score	***Ranking***
42-56	Excellent Condition
26-41	Good Condition
16-25	Fair Condition
< 16	Poor Condition

Figure 2.4 Watts Branch Stream Nomenclature

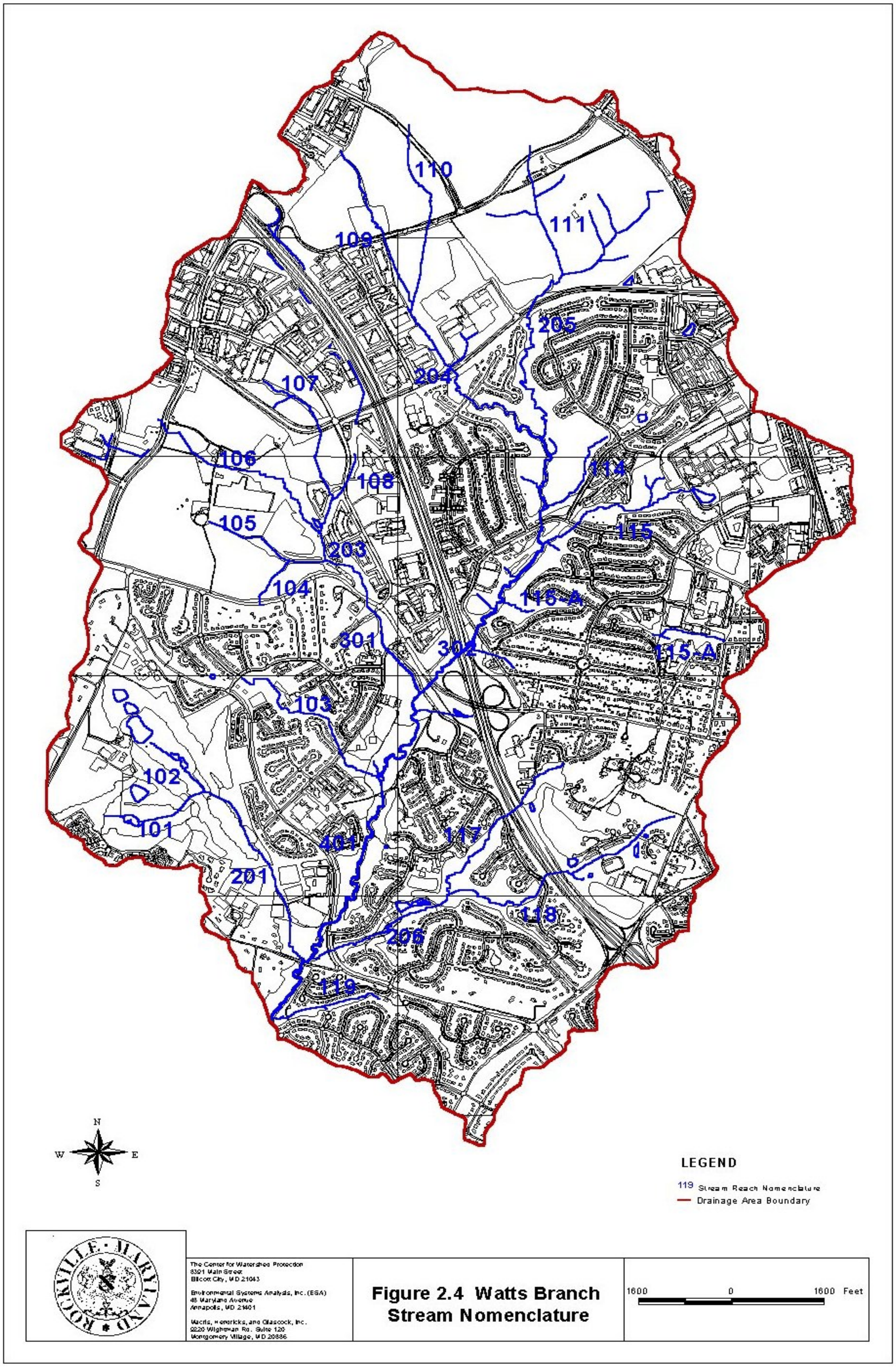
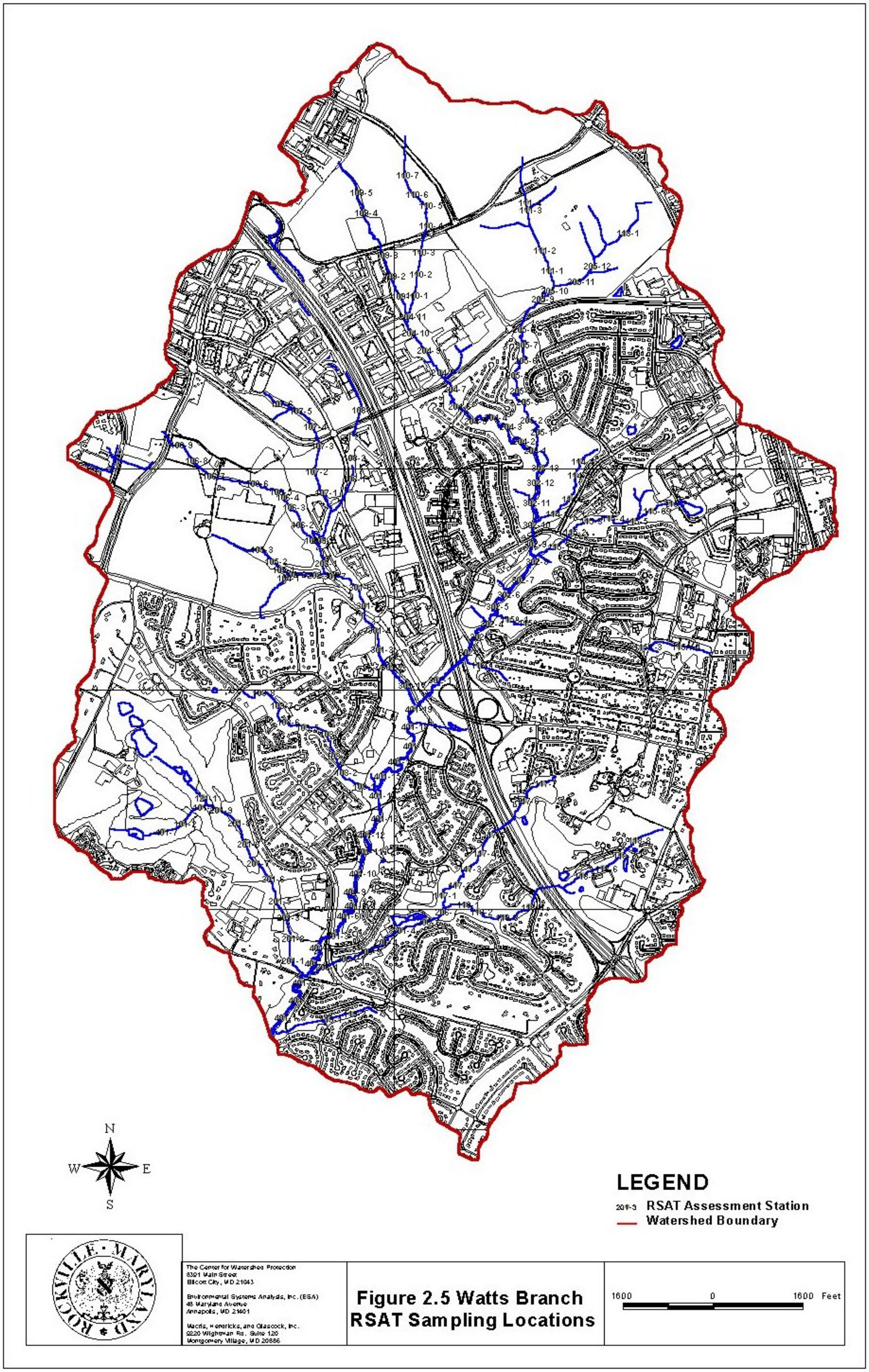


Figure 2.5 RSAT Sampling Locations



Evaluation Category	Excellent	Good	Fair	Poor
1. **Channel Stability**	• >80% stable banks • Outside banks <2' high, very stable • Exposed roots lacking • Channel, highly resistant **9-11**	• 71-80% stable banks • Outside banks 2-3' high, stable • Exposed roots old, large • Channel, resistant **6-8**	• 50-70% stable banks • Outside banks 3-4' high, unstable • Exposed roots young, common • Channel, erodible **3-5**	• <50% stable banks • Outside banks >4', highly unstable • Exposed roots young, abundant • Channel, highly erodible **0-2**
2. **Channel Scouring/Sediment Deposition**	• <25% embedded silts sands • High number of deep pools • Sand deposits rare, absent • Point bars fully incorporated • Water clear • Riffles bends frequent **7-8**	• 25-50% embedded silts sands • Moderate number of deep pools • Sand deposits uncommon • Point bars stable, vegetated • Water slightly turbid • Riffles bends common **5-6**	• 50-75% embedded silts sands • Low-moderate number of deep pools • Sand deposits common • Point bars large, unstable • Water generally turbid • Riffles bends not common **3-4**	• >75% embedded silts sands • Few, if any deep pools • Sand deposits predominate • Point bars unstable with fresh sand • Water opaque • Riffles bends, general lack of **0-2**
3. **Physical In-Stream Habitat**	• Wetted perimeter >85% • Riffle run pool, diverse habitat • Pools >24" dense cover structure • Riffle substrate >50% cobble gravel **7-8**	• Wetted perimeter 61-85%. • Riffle run pool, relatively diverse • Pools 18-24" some cover structure • Substrate 30-50% cobble gravel **5-6**	• Wetted perimeter 40-60% • Riffle run pool, few pools • Pools 12-18" little cover structure • Substrate 10-30% cobble gravel **3-4**	• Wetted perimeter <40% • Riffle run pool, poor habitat • Pools <12" no cover structure • Riffle substrate <10% cobble gravel **0-2**
4. **Water Quality**	• Clarity, visibility 3 ft. > • No odor • Substrate fouling 0-10% **7-8**	• Clarity, visibility 1.5 - 3.0' • Slight organic odor • Substrate fouling 11-20% **5-6**	• Clarity, visibility 0.5 - 1.5' • Moderate on-going odor • Substrate fouling 21-50% **3-4**	• Clarity, visibility <0.5' • Strong organic odor • Substrate fouling >50% **0-2**
5. **Riparian Habitat Conditions**	• Forested buffer >200' • Canopy closure $\geq$80% • Bank vegetation 90% • Adjacent wetlands, 100-200' **6-7**	• Forested buffer 100-200' • Canopy closure 60-79% • Bank vegetation 70-90% • Adjacent wetlands, 200-500' **4-5**	• Riparian buffer 50-100' • Canopy closure 50-60% • Bank vegetation 50-70% • Adjacent wetlands, 500'> **2-3**	• Riparian buffer <50' • Canopy closure <50% • Bank vegetation <50% • Adjacent wetlands, rare to none **0-1**
6. **Aesthetic Rating**	• Human refuse, little to none • Vegetative matrix natural state **6-7**	• Human refuse, minor • Vegetative matrix minor disturbance **4-5**	• Human refuse, moderate • Vegetative matrix moderate disturbance **2-3**	• Human refuse, extensive • Vegetative matrix vegetation lacking **0-1**
7. **Remoteness**	• Access 500'> **6-7**	• Access 500'< **4-5**	• Access Roadside or Trail **2-3**	• Access In Backyards **0-1**

Table 2.4 ESA Modified RSAT Evaluation Method (Based after Galli, 1996)

It is of note that this RSAT system does not correspond with the total numeric scores for all of the seven evaluation categories (i.e., the sum of ranges listed for the individual evaluation categories for "excellent" would be 48-56). This subjective ranking system was developed as a result of numerous field trials and modified based on the best professional judgement of biologists and planners who have expertise in the field of stream ecology. The result is a ranking system which has been scaled to effectively characterize and differentiate stream reaches, including those which have been impacted and/or urbanized. Although the rankings are subjectively based, the scores are absolute, and therefore reaches with a higher score are in better overall condition than reaches with lower scores, regardless of the category. Thus, when reviewing the data, emphasis should be placed on the numeric score of the station or reach rather than the descriptive category in which the score falls.

2.2.2.1 RSAT Results

Of the 132 RSAT stations sampled during this study, only four stations ranked "excellent", and only two ranked "poor". The remaining 126 stations were found to be either "good" or "fair". The highest single score (45) was found at a station on a first order stream located on the Thomas Farm (Fallsgrove), and the lowest (10) occurred at a station on a first order stream immediately downstream of I-270 which flows through the Fallsmead community. When individual scores were averaged within stream reaches, all of the reaches rated either "fair" or "good" (see Figure 2.6 and Table 2.5).

The stream reach with the highest average score (33.1) is a first order tributary located on the Lakewood Country Club; the stream with the lowest average score (21.8) is a second order tributary which flows through the community of Fallsmead in the southern portion of the study area. It is worth noting that the entire main stem of Watts Branch within the study area had average scores in the "good" range.

As outlined in Table 2.4, streams with "good" scores generally have more stable banks, a cleaner substrate, a diversity of habitat types including deep pools, good water quality, forested buffers, and typically exist in a relatively natural setting. The RSAT scores are weighted in favor of channel stability, sediment deposition, in-stream habitat, and water quality. However, because the scoring is cumulative, streams with an overall "good" score can have deficiencies in one or more of the seven evaluation categories. Therefore, a "good" score does not necessarily preclude the need for rehabilitation, stabilization, and/or other management activities. The converse is also true. Streams rated "fair" may exhibit "excellent" or "good" characteristics in one or more of the evaluation categories. For this reason, individual scores for a given station should be consulted to gain an understanding of the overall condition of the stream reach.

Figure 2.6 RSAT Stream Reach Condition Rating Results

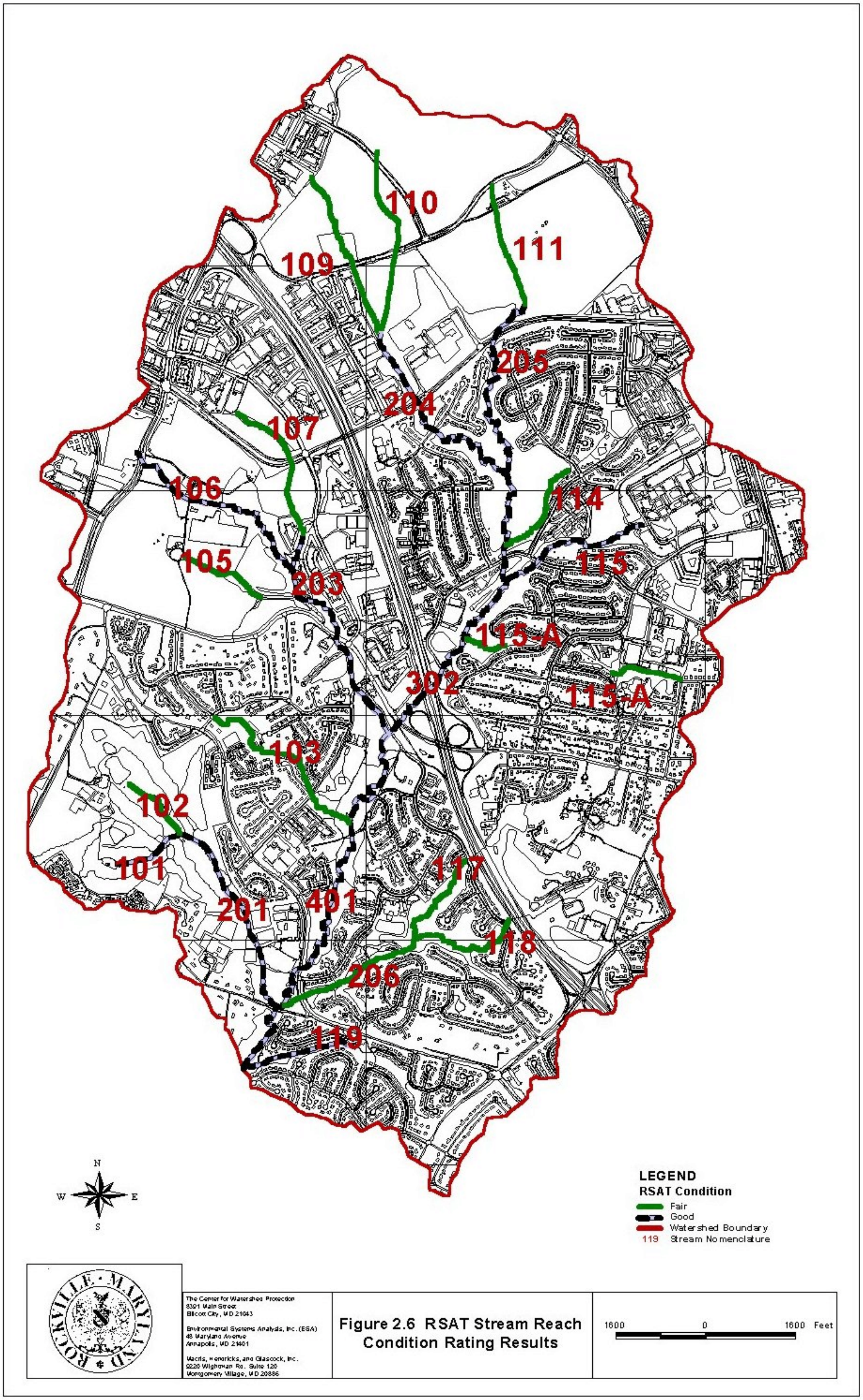


Table 2.5 Summary of Watts Branch RSAT Scores by Segment

Stream Segment	# RSAT Data Points / # of Points Investigated	Channel Stability (avg.) (0-11)	Scouring & Deposition (avg.) (0-8)	Physical In-Stream Habitat (avg.) (0-8)	Water Quality (avg.) (0-8)	Riparian Habitat Condition (avg.) (0-7)	Aesthetic Rating (avg.) (0-7)	Remoteness (avg.) (0-7)	Average Score for Reach (Sum of avg.'s)	Ranking of Stream Segment
101	3/3	9.7	6.0	5.7	4.0	2.0	4.7	1.0	33.1	Good
102	1/1	5.0	6.0	5.0	4.0	1.0	2.0	1.0	24.0	Fair
103	9/9	4.4	4.1	4.3	5.5	2.1	2.4	1.4	24.2	Fair
104	0/1	ND	ND	ND	ND	ND	ND	ND	ND	Non-Rsat
105	3/3	5.0	2.0	2.3	4.3	3.3	3.0	3.7	23.6	Fair
106	5/9	6.8	4.8	5.4	4.4	4.6	4.6	3.8	34.4	Good
107	6/6	3.3	4.0	3.5	5.0	2.0	2.0	3.3	23.1	Fair
108	0/3	ND	ND	ND	ND	ND	ND	ND	ND	Non-Rsat
109	4/6	4.8	3.3	2.5	2.8	3.8	2.5	2.5	22.0	Fair
110	7/7	5.3	3.1	2.4	5.0	3.4	2.3	1.4	22.9	Fair
111	4/4	6.0	4.3	3.5	5.0	2.5	2.5	1.0	24.8	Fair
114	0/4	ND	ND	ND	ND	ND	ND	ND	ND	Non-Rsat
115	7/7	4.0	4.1	3.3	4.6	3.9	3.6	2.7	26.2	Good
115A	3/4	3.7	2.7	2.7	5.0	3.3	3.0	1.7	22.1	Fair
117	5/7	3.4	3.0	2.4	5.0	4.6	3.4	3.2	25.0	Fair
118	4/8	4.0	3.0	3.3	3.8	3.8	3.3	2.8	23.8	Fair
119	2/2	9.0	4.5	4.0	3.5	4.0	4.0	1.0	30.0	Good
201	8/9	5.0	5.1	4.5	4.5	2.3	2.6	2.3	26.3	Good
202	0/2	ND	ND	ND	ND	ND	ND	ND	ND	Non-Rsat
203	2/3	8.0	5.0	4.0	4.5	2.0	2.5	1.0	27.0	Good
204	10/11	6.4	5.1	4.1	4.8	4.6	3.7	3.3	32.0	Good
205	9/12	5.3	3.9	4.3	4.3	4.3	3.7	2.4	28.2	Good
206	7/7	3.6	3.4	3.1	5.0	2.7	2.4	1.6	21.8	Fair
301	6/7	5.3	4.7	4.7	4.0	2.8	3.5	2.5	27.5	Good
302	12/13	5.8	4.7	4.4	4.8	4.4	4.3	4.1	32.5	Good
401	18/19	4.6	3.5	4.3	4.4	3.8	3.2	2.2	26.0	Good

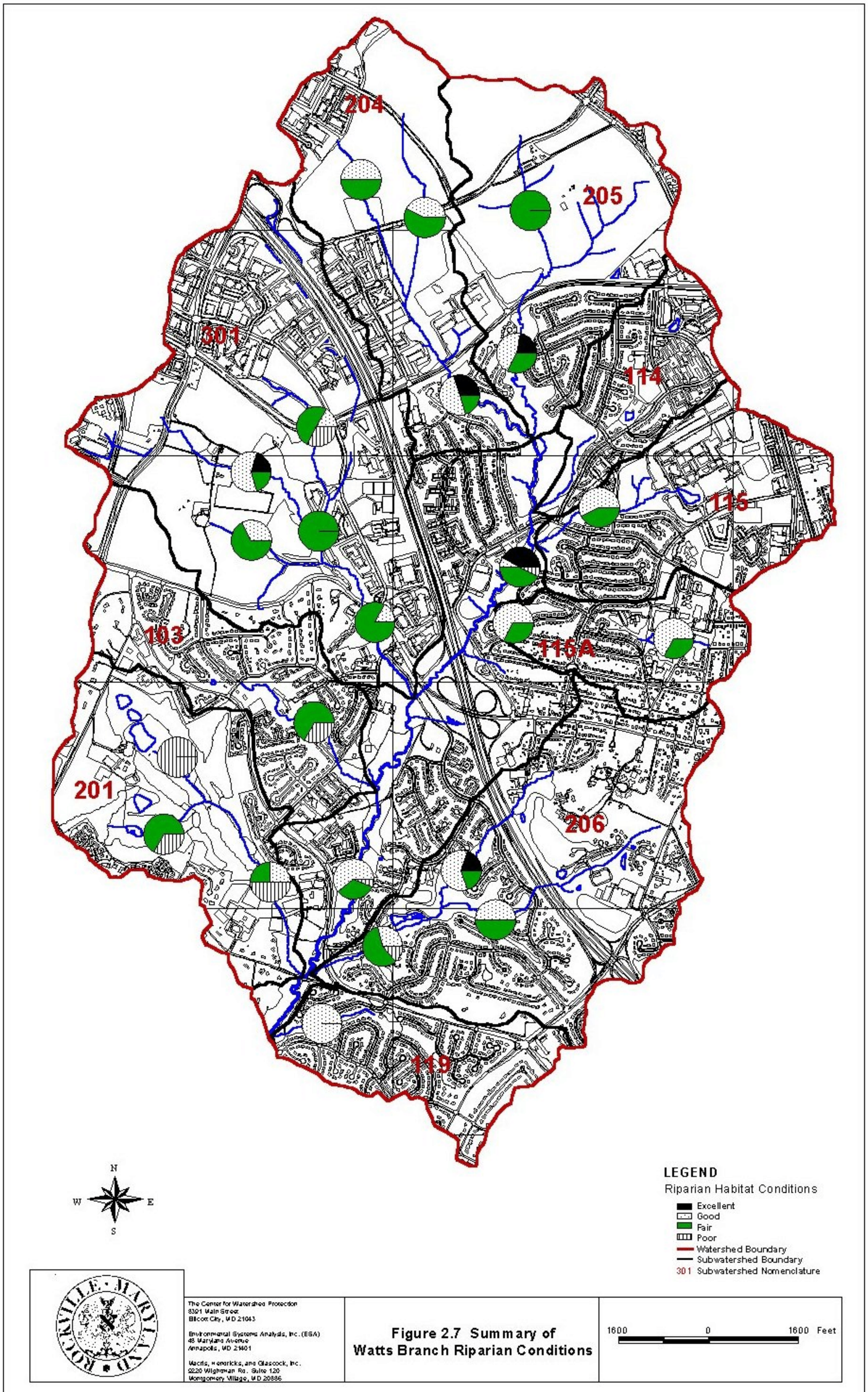
ND = No Data. Station not investigated because it lacked either a riffle or were found to be ephemeral or intermittent, concrete lined, or piped.

This point is evident when the riparian habitat conditions criteria are analyzed (Figure 2.7). For example, reach 101 (the Lakewood Country Club reach which had the highest overall average score) had a riparian habitat score that was fair (about 65%) or poor (about 35%). The low riparian scores were largely due to a lack of dense forest cover along the reach. Consequently, looking at the results of individual RSAT criteria is useful from a management strategy standpoint. For example, reforestation and riparian enhancement is often a cost-effective watershed rehabilitation tool. Figure 2.7 can be used as a diagnostic tool to identify reaches that are in most need of riparian reforestation and enhancement.

One of the primary purposes of the RSAT assessment is to identify candidate sites for stream rehabilitation and to provide context for specific design concepts, such as stream channel stabilization or habitat creation. For example, areas of significant erosion that are present within the RSAT channels were identified and targeted for rehabilitation by scoring these sites low on the channel stability index[3]. Concepts to address erosion and bank stabilization are recorded on individual data sheets at each station (see Appendix C). In addition, site conditions such as existing deficiencies or problems in stream and riparian areas, safety and property hazards, and wetland creation or enhancement opportunities are noted in the field. A more detailed presentation of the stream rehabilitation inventory is presented in Section 4.

[3] While field observations and RSAT scoring identified reaches of erosion and instability that showed potential for stream rehabilitation, the ranking system described in Section 4 ultimately narrowed the list of candidate stream rehabilitation sites.

Figure 2.7 Summary of Watts Branch Riparian Conditions



2.2.3 Conclusions From Stream Channel Conditions Assessment

Based on the findings from the channel enlargement assessment, RGA and RSAT, some general observations can be made with regard to the best and worst stream reaches within Watts Branch can be made (in terms of stability and physical habitat). Key findings include:

- Station 1 (see Figure 2.1 for station locations) is beginning to show signs of stress and is close to being in an "adjustment" period (i.e, evolving towards a new equilibrium in response to altered hydrology). The RSAT scores in the vicinity of Station 1 are good. This suggests that since the channel is trending towards an adjustment period where it is striving to achieve a new equilibrium, the overall physical health of the stream might be expected to decline, particularly in the absence of management measures.

- Station 2 was a "non-RSAT" reach due to the lack of flow. This station is representative of a highly impacted reach of stream and is perhaps the worst portion of the entire watershed. Much of this can be attributed to the fact that this subwatershed has the highest impervious cover of the ten subwatersheds (50%), and much of the historic channel has been piped through the subwatershed. The highly urban nature and pipe infrastructure cause hydrologic responses to be "flashy" with little groundwater recharge and return flows to supplement dry weather baseflow periods. The biological community is greatly impacted as a consequence.

- Station 3 is somewhat anomalous in that it is "in adjustment," yet scored excellent on the RSAT. The station shows indications of aggradation, which is the primary reason for the stability index being in the "in adjustment" range. The source of the aggradation is likely due, in part, to the relatively flat slope in this reach and the downstream grade control (i.e., Nelson Street culvert). Despite the aggradation, the channel appeared to be more stable than some of the stations that were experiencing active downcutting. This was also reflected in the RSAT score.

  Further complicating the conditions at this site is the fact that it has a large enlargement ratio (5.62), which suggests that the channel is expected to ultimately widen and/or downcut substantially. The enlargement ratio may be over-stated, however, due to the fact that the current channel cross-section location was a few hundred feet upstream of the historic channel cross-section location. This shift in locations was due to a gas line crossing which is associated with a channelization of the stream (i.e., concrete-lined channel) just upstream of the Nelson Street culvert crossing. Either the gas line crossing or the culvert may have contributed to the small historic cross-sectional area. Similarly, it was necessary to locate the RSAT station upstream of the gas right-of-way to avoid the influence of the channelization.

- Stations 4 through 8 are all "in adjustment," where they are evolving towards a new equilibrium. The RSAT scores from these stations were either "good" or "fair," with Stations 4 and 5 (Woodley Gardens Park) exhibiting the most impacted reaches.

- Stations 9 and 10, the most downstream stations, are in "transition." It is possible that this reach of the stream has evolved the most of all the reaches and is actually moving from the "transition" stage into the "stable" stage. The RSAT scores for these reaches were "fair" which

- supports the above observation. In other words, the channel has reached a maximum point in the adjustment process and as a consequence, the physical habitat has been impacted.

2.3 Hydrologic Modeling

An updated TR-20 hydrologic analysis of the Rockville portion of the Watts Branch watershed was undertaken as part of this study. The analysis was undertaken to provide additional runoff information to use in assessing the geomorphologic status of streams, to assess the effect of existing and proposed stormwater facilities, to use for concept stormwater control facility designs and to update a hydrologic study previously prepared for the City (ETA, 1989). TR-20 is a widely applied hydrologic model developed by the Natural Resource Conservation Service's (NRCS). The program is a physically based event model which computes direct runoff resulting from any synthetic or natural rainstorm. Runoff hydrographs are generated and routed through channels and reservoirs. Peak discharges, the time of their occurrence, water surface elevations and duration of flows can be computed at specified cross-sections or structures.

2.3.1 Background

Engineering Technologies Associates (ETA), Inc. prepared a hydrologic study for the City of Rockville in April 1989 that included a hydrologic analysis using TR-20, a hydraulic analysis using the United States Army Corps of Engineers HEC-2 Water Surface Profile computer program, an analysis of existing and proposed stormwater management facilities and a feasibility study of proposed stormwater facilities.

The ETA hydrologic study evaluated a series of watershed development scenarios including: Predevelopment, Existing Development with Existing and Authorized Facilities and Ultimate Development with Existing and Authorized Facilities. Runoff parameters used in ETA's TR-20 models were developed from mapping and information provided by the City of Rockville. Runoff Curve Number (RCN) values, Time of Concentration (Tc) values and Cross Section parameters used in the ETA model are documented in Appendix D of ETA's report. Data for each of the structures modeled came from a number of sources and is not documented as clearly.

Macris, Hendricks and Glascock, P.A.(1999) revised and updated ETA's 1989 TR-20 hydrologic model. Revisions to the model include adding the 6 month, 1-year and 18 month design rainfall values to the model, deleting the 5 year rainfall value from the model, correcting the drainage area of sub-watershed W9 (0.853 to 0.0853 square miles) and adjusting the pattern of subwatershed runoff combinations to provide nodes at or near each of ten historic cross section locations selected for detailed study. Updates to the model included further subdivision of previously undeveloped sub-watersheds to more adequately define current development patterns, runoff flow patterns and existing and potential proposed stormwater management facilities (see Section 3.5 for the results that include the effect of potential stormwater management retrofit sites).

2.3.2 Results

Predevelopment Condition

Only minor revisions were made to ETA's Predevelopment Condition scenario for this study. Input and summary output from the TR-20 model are included in Appendix D. Peak predevelopment discharges for each of the ten historic cross sections and at other selected locations within the watershed are shown in Table 2.6. Values are reported to the hundredth to be consistent with the model output; however, it is important to note that discharge estimates are generally considered to be accurate if they are within 30 percent of the "true" discharge.

Table 2.6 Peak Discharges – Predevelopment Condition

Return Period	**6 Month**	**1 Yr**	**18 Month**	**2 Yr**	**10 Yr**	**100 Yr**	
24 Hour Rainfall	**1.7"**	**2.6"**	**3.0"**	**3.2"**	**5.1"**	**7.2"**	
Location	**Qp-cfs**	**Qp-cfs**	**Qp-cfs**	**Qp-cfs**	**Qp-cfs**	**Qp-cfs**	**TR-20 Reference (Area Sq. Mi.)**
Cross Section 1	1.22	30.71	60.87	79.09	327.03	685.77	Struct 2 Resvor (.55)
Cross Section 2	0.27	6.56	14.80	20.13	100.91	228.32	Struct 6 Runoff (.25)
Cross Section 3	3.00	64.19	127.70	166.99	689.54	1304.63	Struct 6 Addhyd (1.33)
Cross Section 4 & 5	4.33	102.28	205.54	269.45	1061.00	1992.86	Struct 14 Addhyd (2.41)
Cross Section 6	4.42	105.09	211.44	277.37	1084.75	2036.40	Struct 17 Resvor (2.52)
MD Route 28	4.42	105.09	211.09	276.20	1057.52	1988.78	Struct 18 Resvor (2.52)
Cross Section 7 & 8	6.21	124.78	262.90	350.57	1525.58	3093.22	Struct 32 Addhyd (3.83)
Hurley Avenue	0.67	13.92	27.71	36.39	163.35	358.33	Struct 39 Resvor (0.32)
Cross Section 9	7.19	144.52	300.84	399.77	1717.95	3508.21	Struct 43 Addhyd (4.45)
Cross Section 10	8.21	144.87	301.44	400.53	1720.48	3513.43	Struct 43 Addhyd (4.47)
City Boundary	10.79	199.82	383.93	497.75	1886.11	4005.42	Struct 70 Addhyd (6.46)

Existing Development Condition with Existing Structures

Revisions that were made to ETA's Existing Condition scenario included further subdivision of previously undeveloped sub-watersheds. Documentation for Runoff Curve Number (RCN) values, time of concentration (Tc) values, cross section parameters for the new subareas, input and summary output from the TR-20 model are included in Appendix D. Table 2.7 shows the peak discharges for each of the ten historic cross sections and at other selected locations within the watershed. It is of note that the 1-yr and 18-month modeled flows for this scenario are in good agreement with the bankfull flows estimated from the field survey data (see Table 2.1).

Table 2.7 Peak Discharges - Existing Condition with Existing Structures

Return Period	6 Month	1 Yr	18 Month	2 Yr	10 Yr	100 Yr	
24 Hour Rainfall	1.7”	2.6”	3.0”	3.2”	5.1”	7.2”	
Location	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	TR-20 Reference (Area Sq. Mi.)
Cross Section 1	51.10	86.15	128.37	186.45	575.43	1113.15	Struct 2 Resvor (.55)
Cross Section 2	47.25	129.31	172.59	195.14	427.57	701.98	Struct 6 Runoff (.25)
Cross Section 3	67.92	140.60	190.46	271.51	1061.31	1791.14	Struct 6 Addhyd (1.33)
Cross Section 4 & 5	139.19	395.11	572.09	652.96	1318.71	2118.80	Struct 14 Addhyd (2.41)
Cross Section 6	153.87	424.06	568.60	645.37	1349.17	2049.24	Struct 17 Resvor (2.52)
MD Route 28	134.95	407.51	544.37	615.92	1281.57	1957.17	Struct 18 Resvor (2.52)
Cross Section 7 & 8	142.77	429.76	653.00	778.86	2044.48	3385.91	Struct 32 Addhyd (3.83)
Hurley Avenue	6.19	39.15	61.91	74.55	245.56	454.01	Struct 39 Resvor (0.32)
Cross Section 9	156.55	498.93	745.84	887.34	2371.64	3942.21	Struct 43 Addhyd (4.45)
Cross Section 10	157.11	500.74	747.94	889.95	2378.79	3949.74	Struct 43 Addhyd (4.47)
City Boundary	190.59	610.75	874.75	1010.98	2514.83	4140.22	Struct 70 Addhyd (6.46)

Ultimate Development Condition with Existing Structures

For this model run, the ultimate development condition was run with existing structures in place. This will provide a frame of reference to assess the effect that new structures as well as retrofit structures will have on the stream. Table 2.8 shows the peak discharges under ultimate development conditions with existing structures for each of the ten historic cross sections and at other selected locations within the watershed.

Table 2.8 Peak Discharges – Ultimate Condition with Existing Structures

Return Period	6 Month	1 Yr	18 Month	2 Yr	10 Yr	100 Yr	
24 Hour Rainfall	1.7”	2.6”	3.0”	3.2”	5.1”	7.2”	
Location	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	Qp-cfs	TR-20 Reference (Area Sq. Mi.)
Cross Section 1	76.79	199.33	289.96	330.04	724.98	1270.56	Struct 2 Resvor (.55)
Cross Section 2	109.89	222.21	274.45	300.84	554.63	834.91	Struct 6 Runoff (.25)
Cross Section 3	101.46	258.63	383.74	454.18	1198.66	1909.03	Struct 6 Addhyd (1.33)
Cross Section 4 & 5	193.58	502.87	683.54	732.23	1440.51	2212.93	Struct 14 Addhyd (2.41)
Cross Section 6	209.45	512.80	672.10	721.35	1479.56	2120.98	Struct 17 Resvor (2.52)
MD Route 28	200.61	498.04	645.13	694.15	1396.92	2068.01	Struct 18 Resvor (2.52)
Cross Section 7 & 8	362.52	994.10	1315.28	1437.22	2866.44	4053.09	Struct 32 Addhyd (3.83)
Hurley Avenue	22.06	84.40	127.96	150.21	364.19	653.68	Struct 39 Resvor (0.32)
Cross Section 9	390.18	1102.56	1470.22	1613.44	3309.53	4706.55	Struct 43 Addhyd (4.45)
Cross Section 10	390.73	1104.41	1473.10	1617.20	3316.86	4715.70	Struct 43 Addhyd (4.47)
City Boundary	394.26	1077.45	1438.94	1588.33	3322.75	4918.60	Struct 70 Addhyd (6.46)

2.4 Watts Branch Water Quality

The overall water quality of Watts Branch is an important consideration of the management plan. Water quality concerns include public health issues associated with water contact recreation in the stream, protecting the downstream drinking water supply intake on the Potomac River, and reducing the nutrient load to the Chesapeake Bay. One of the goals of the plan is to reduce the pollutant load associated with stormwater runoff by implementing stormwater retrofits, streambank rehabilitation practices, and pollution prevention outreach techniques.

It is beyond the scope of this project to collect and analyze water quality, macroinvertebrate, or fish samples; however, some data collection and analysis has previously been performed in the Watts Branch watershed. This section provides a brief overview of some of the data collection efforts. (Note, up to eight sampling locations will be monitored for macroinvertebrate community assessment as part of Phase III of the plan development.)

EA Engineering, Science, and Technology, Inc. (1997) summarized historic data collection efforts in Watts Branch as part of an environmental assessment for the City of Rockville's proposed sewer upgrade. Table 2.10 has been adopted from a summary table in EA's 1997 report. In general, the sampling stations on Watts Branch exhibit some degree of impairment from a water quality and fish and macroinvertebrate standpoint. This is consistent with what one would expect to see in an urban stream with impervious cover of about 28 percent.

Table 2.9 Summary of Historic Watts Branch Water Quality, Macroinvertebrate, and Fish Data (Adopted from EA, 1997)

Location	Water Quality	Macroinvertebrates	Fish	Comments	Data Collector
• Upper Watts Branch • Woodley Gardens • Woottons Mill Park • Research Blvd • Lower Watts Branch (Scott Dr.)	• Slightly turbid Acceptable readings for temperature, pH, dissolved oxygen, and conductivity	• Poor • Fair • Poor • Poor • Poor	• Fair • Fair • Fair • Good • Fair	Sampling conducted from March - April 1997; visible signs of channel erosion at all stations	EA Engineering, Science and Technology Inc.
• Woodley Gardens • Lower Watts	No Data	• Poor • Fair	• Good • Fair	Macroinvertebrate sampling conducted in March 1996; fish sampling conducted in July (Woodley) and September (Lower Watts) 1996	Montgomery County DEP
• Watts Branch above College Gardens • King Farm (3 stations)	• Fair to Good • Very Poor to Fair	• Highest quality station of 4 sampled; mayflies and caddisflies present • Some caddisflies and mayflies present	No Data	• Winter 1995, Spring and Fall 1996 • Winter 1995, Spring and Fall 1996	Loiderman and Associates
• Woottons Mill Park	No Data	• Mayflies and caddisflies present	No Data	May, June, and July 1991	MD Dept. of Natural Resources (DNR)
• Woottons Mill Park	• Good (despite urban development)	• Some mayflies and caddisflies present	• Good diversity	October 1990	MD DNR
• Mainstem Watts Branch	Water Quality Index • Good • Excellent • Permissible	No Data	No Data	• 1972 • 1974-1975 • 1976-1979	Montgomery County DEP

2.5 Planning Charette

The Watts Branch study was structured to involve the public at various levels throughout the course of the project, with a strong emphasis on getting early input and involvement from the public in the planning process. This allows for contentious issues to be identified and addressed early in the planning phases and helps identify the important issues are to watershed residents. Establishing stakeholder pride and ownership in the plan leads to a greater chance of project success.

With this in mind, a planning charette with interested stakeholders was sponsored by the City and the Watts Branch Partnership on October 30, 1999, in which the preliminary findings of the geomorphic assessment, stream assessment and retrofit and stream rehabilitation inventories were presented. Approximately 30 people attended the planning charette, representing a variety interests and backgrounds. Stakeholders included citizen associations, interested homeowners, environmental planners, and staff from various agencies in Montgomery County and the City of Rockville. Despite the positive turnout, several key stakeholders were not represented, including utility companies, developers, and office and institutional interests. Keeping these players informed and engaged in the watershed study will be critical to the overall rehabilitation effort in the watershed.

The charette was structured in two parts. The first was comprised of a presentation of the watershed assessment tasks and the findings to date, and the second part involved stakeholders participating, in groups of 5-10 people, in one of three watershed exercises. Where appropriate and feasible, the results of the three watershed exercises have been incorporated throughout the Watts Branch Watershed Plan. For example, the results from the ranking exercise have been factored into the development of a scoring system that will help prioritize retrofit sites. In addition, a basic concept design that one group developed was adopted as the proposed retrofit for the site. The general scenario of each exercise is presented below.

2.5.1 Exercise #1 - Retrofit Ranking for Selected Subwatershed

In this exercise, each group was presented with a subwatershed in Watts Branch with candidate retrofit sites. A summary of subwatershed conditions/characteristics was provided along with the field inventory sheets for each proposed retrofit site. The inventory sheets described the contemplated retrofit, provided a concept sketch, and listed both constraints and opportunities for implementation.

Each group was initially responsible for identifying realistic watershed rehabilitation goals that could be achieved given the current land use and stream conditions. Each group was provided with a “Fact Sheet” summarizing the watershed assessment efforts on Watts Branch to date, and was asked to prepare a list of what they thought might be improved. To facilitate this task, the group was also given templates for “sensitive,” “impacted,” ”restorable” and “non-supporting” streams to provide context on what typical management objectives are. Next, each group was asked to list ten goals that the Watts Branch study should attempt to accomplish.

Perhaps the most challenging component of this exercise was the task of refining a stormwater management site ranking system, scoring individual sites and ranking them in order of highest to lowest score. The exercise used the Rockmead Park tributary, a small portion of the total Watts Branch watershed within the City of Rockville, as the case study.

Specifically, the group was provided with five candidate retrofit sites that were identified within the Rockmead Park tributary as part of a retrofit inventory, and asked to evaluate the potential projects and to develop a ranking system that would assist in the prioritizing of the projects. The ranking scheme was based on such factors as treatment capabilities, physical feasibility, cost, and environmental impacts.

Results

Two groups participated in this exercise, and the goals and priorities they identified were:

- Improve the effectiveness and enforcement of existing regulations (i.e., the mass grading of King Farm was noted)
- Reduce the potential for further channel enlargement by controlling velocities and volumes of stormwater runoff
- Improve the overall ecological conditions in stream reaches from “fair” to “good”
- Promote native vegetation in the riparian corridor
- Improve water quality and incorporate advanced stormwater management techniques on King and Thomas Farms
- Increase public awareness and education with emphasis on changing watershed behaviors
- Create open/green space and passive recreational opportunities

Both groups debated how to most appropriately weight the ranking factors. In general, a greater emphasis was placed on the ability of a retrofit to provide water quality and channel protection. Less emphasis was placed on factors such as cost and impact on natural resource.

2.5.2 Exercise #2 - Public Education and Outreach Program Development

In the second exercise, the group was charged with developing an effective public education and outreach program based on real world constraints such as budget. At the outset of the exercise the group filled out and compared responses to a questionnaire on common polluting behaviors, such as lawn care, pet wastes, and car washing (Swann, 1999). The questionnaire provided an understanding of the obstacles that need to be overcome by proposed programs.

Next, each group was asked to identify which resident behaviors they felt were most important to change, and to develop a media campaign to address it. The challenge was to develop a program with the most significant and long lasting impact. The exercise scenario assumed that the group was attempting to obtain grant funds to finance the education initiative. They were responsible for identifying a target audience, developing a slogan/theme, and determining the media through which the message would be conveyed. To facilitate the exercise, unit costs for various media campaigns were provided along with representative examples of certain approaches. Lastly, the group was challenged to come up with at least one innovative approach to public education and outreach.

Results

There was one group that participated in this exercise. Responses to the questionnaire were varied and largely inconclusive due to the small sample size. Perhaps the most telling result of the survey was that the use of lawn care companies is fairly prevalent and that these companies might be a good group to target for education initiatives. For the media campaign, the group decided to target homeowners with a three-pronged attack on lawn fertilization, pet waste management, and automotive/equipment maintenance. The campaign slogan developed was “We are all part of the problem.” Eddy the fish was designated as the campaign mascot/spokesperson. Public service announcements and refrigerator magnets were the proposed methods of conveying the message.

2.5.3 Exercise #3 - Retrofit Design

The third exercise required participants with a bit more technical experience (i.e., engineers, architects, planners). The goal was to outline a basic conceptual design for a stormwater management retrofit site. The exercise was conducted using one of the retrofit sites identified in the retrofit inventory conducted for Watts Branch watershed. The groups were provided with basic information such as drainage area, impervious cover, soil type, etc. Their challenge was to fill out field retrofit forms with a concept design(s). Guidance for retrofit rules of thumb such as treatment volume and required area were provided.

Each group was provided with the basic guidance that their retrofit strategy should probably place an emphasis on restoring stream channel morphology by placing a priority on retrofits that provide the most storage for channel protection, but also provide water quality controls for pollutant reduction. Some other rehabilitation goals they were asked to consider included: reduce trash in the streams, protect and preserve existing forests and wetlands, maintain existing recreational areas, and protect existing utilities in or near streams from erosion damage. A last constraint that the group was asked to address was to meet watershed protection objectives while minimizing impacts to existing facilities, forests, or other natural features.

Two sites were evaluated in this exercise. The first was a 62-acre catchment near Glenora Park and the second was the 84-acre catchment to the- pond at College Gardens Park.

Results

There were two groups that participated in this exercise. One group developed a concept design for the Glenora Park site and the other group developed a concept design for the College Gardens site. In general, both groups noted the difficulty in fitting in the required target volumes without significantly impacting some existing condition such as recreational space (i.e., playgrounds, ball fields, picnic areas, etc.), forest, or wetlands. In the case of Glenora Park, the group felt that options treating the full target volumes for water quality and channel protection would be too drastic and likely would not be accepted/supported by the local citizens. The College Gardens site had a bit more flexibility and room to work with, and the group proposed to enlarge the pond and relocate some of the impacted play areas.

2.5.4 General Comments From Participants

The stakeholders that participated in the planning charette generated excellent dialogue about important issues with respect to overall watershed protection goals and their priorities in mitigation/rehabilitation efforts.

Based on the charette evaluation forms that were completed and documentation of the discussion, some of the key observations/impressions that participants came away with were:

- It was generally acknowledged that it is extremely difficult to go into developed watersheds and locate stormwater retrofits that are effective without making some difficult decisions about land use and open space.
- Watershed residents indicated a desire to study the issues more closely and to have access to the preliminary findings of the retrofit and stream rehabilitation inventories.
- Some interest was expressed about obtaining water quality data that supplemented the channel erosion data. Citizens are just as concerned about the quality of the runoff as they are about the condition of the stream channel.
- It was noted that it will be important to continue to educate the citizens of the watershed, and to particularly explore methods to get the message out to those who do not attend charettes, workshops, or public meetings.
- Participants expressed a desire to visit some representative sites where retrofits were being proposed.